GO GREEN
$AVE GREEN

2023 HEAT PUMP WEBINARS

Save energy, lower your heating costs and keep cool this summer.
Learn what heat pump is right for you with our summer series!

walkingmountains.org/heat-pump-webinars

2023 HEAT PUMP WEBINARS

MAY 17
Heat Pumps for New Single Family Homes
for homeowners, builders, developers and realtors

JUN 07
Mini-Split Heat Pumps for Existing Homes
for homes with radiant baseboard or in floor heat

JUL 12
Heat Pumps for Existing Homes with a Duct System
replacing a your aging heating system or adding cooling

JUL 26
Heat Pumps for New Single Family Homes
for homeowners and realtors

AUG 16
Heat Pump HVAC systems for New Homes, Condos and Townhomes
for builders, architects, and developers

All webinars from 5:00pm-6:00pm

SCAN THE CODE FOR MORE INFO

walkingmountains.org/heat-pump-webinars

2023 HEAT PUMP WEBINARS

HOLY CROSS ENERGY
EST. 1939

walking mountains®
sustainability

EnergySmart
COLORADO

BENEFICIAL ELECTRIFICATION
ELECTRIFY!
LEAGUE OF COLORADO

HIGH COUNTRY
CONSERVATION CENTER

CORE

GARFIELD
CLEAN ENERGY

CLEER
CLEAN ENERGY ECONOMY FOR THE REGION

loveelectric.org

Love Electric

Love Electric aims to accelerate the adoption of heat pumps, heat pump water heaters, and other efficient electric technologies in homes and businesses across Colorado, to lower consumer energy costs, reduce greenhouse gas emissions, and provide improved health, comfort and other benefits. Love Electric is an initiative of the Beneficial Electrification League of Colorado (BEL-CO).

For Consumers

- Get Started
- Find Rebates
- Find an Installer
- Financing
- Common Questions

Residential rebates

25% of total project cost for any qualifying project up to

$5,000/year

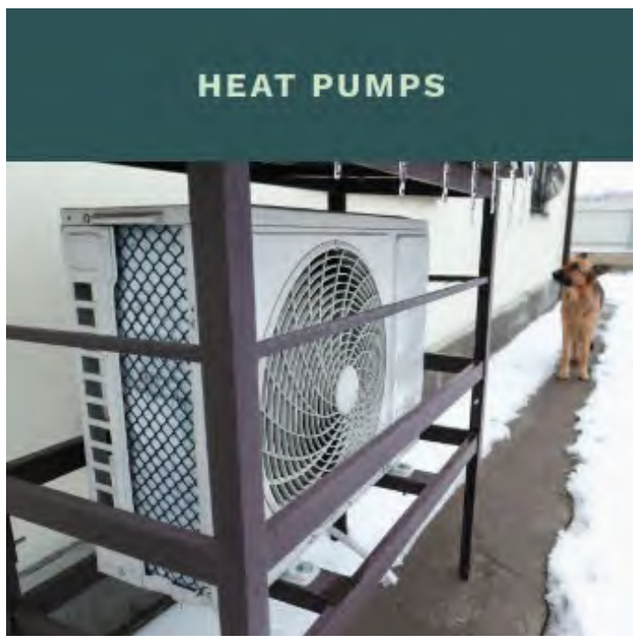
Maximum rebate of $5,000/year per account and $15,000/year per member.

New Construction Residential Rebates

25% of total cost for any qualified equipment:

$15,000/new home

www.holycross.com/rebates/#heatpumps



Ducted heat pumps must have:

- Heating Seasonal Performance Factor (HSPF2) of 8.1+
- Coefficient of Performance (COP) @ 5° of 1.75+

Ductless mini-split heat pumps must have:

- Heating Seasonal Performance Factor (HSPF2) of 9.5+
- Coefficient of Performance (COP) @ 5° of 1.75+

Other requirements:

- Outside unit must be elevated at least 12 inches off the ground
- Garfield County (Climate Zone 5) = Heat pump rated to 5°F minimum
- Eagle County (Climate Zone 6), Gunnison and Pitkin Counties (Climate Zone 7) = Heat pump rated to -5°F or colder minimum

Recommended: Load calculation to right size heat pump system & derate for high elevation

FOR YOUR HOME

Energy Saving Rebates

EnergySmartColorado

Boulder County

energySMART

Chaffee County

COLORADO CHAFFEE COUNTY EST. 1879

Eagle County including Eagle Valley

walking mountains sustainability

Garfield County

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Gunnison County

GVRHA
GUNNISON VALLEY REGIONAL HOUSING AUTHORITY

Lake County

CLOUD CITY CONSERVATION CENTER

Roaring Fork Valley including Pitkin & Eagle Counties

CORE
Smart energy. Less carbon. More living.

Southwest Colorado including La Plata, Dolores, Montezuma, San Juan & Archuleta Counties

4CORE
Four Corners Office for Resource Efficiency

Summit County

HIGH COUNTRY CONSERVATION CENTER

Yampa Valley including Routt & Moffat Counties

YAMPA VALLEY SUSTAINABILITY COUNCIL

A home energy assessment may be required for rebate eligibility. Visit: https://energysmartcolorado.org/for-your-home for more info.

2023 HEAT PUMP REBATES

HIGH COUNTRY CONSERVATION CENTER

$4,000
Households earning
80-160% Area Median Income

$500
Households earning > 160% Area Median Income

https://highcountryconservation.org/home-energy-audits

(970) 668-5703

walking mountains sustainability

up to **$5,000**
Households earning max ***150% Area Median Income***

up to **$3,000**
Any Household

www.walkingmountains.org/energy

(970) 328-8777

CORE

up to **$7,500**
Holy Cross Energy households

up to **$12,500**
Aspen Electric Household

New Construction: quarterly grants
https://aspencore.org/core-grant

https://aspencore.org/2023rebates

(970) 233-0811

CLEER
CLEAN ENERGY ECONOMY FOR THE REGION

GARFIELD CLEAN ENERGY

up to **$4,000**
ReEnergize Program- max ***150% Area Median Income***

up to **$3,000**
Glenwood Springs Electric Household

https://garfieldcleanenergy.org/gwse-rebates

(970) 704-9200

Heat Pumps Tax Credit

Federal Income Tax Credits-*Existing Homes*:

- 30% of project cost up to $2,000 – Air Source Heat Pump
- 30% of project cost up to $2,000 – Heat Pump Water Heater
- 30% of project cost up to $600 – Electric Panel Upgrade
- Available years: 2023-2032
- $2,000/year limit in total for heat pumps & heat pump water heaters (additional $1,200 available/year for electric panel + other EE improvements)

Colorado Income Tax Credit:

IRA Rebates – Coming Soon!

- 10% of heat pump purchase price
- valid for purchases in 2023 or 2024
- **new and existing homes**
- extends to electrical panel upgrades if needed for the heat pump
- note: tax credit applies as long as the homeowner pays enough state taxes

Good sites with tax incentive information:

www.energy.gov/save/homeowners

www.irs.gov/forms-pubs/about-form-5695

www.irs.gov/credits-deductions/home-energy-tax-credits

www.energystar.gov/about/federal_tax_credits/non_business_energy_property_tax_credits

https://energysmartcolorado.org/tax-credits-incentives

2023 HEAT PUMP WEBINARS

Heat Pumps for New Single-Family Homes

For builders, architects and developers August 16, 2023

David Petroy, NTS Energy LLC
dpetroy@ntsenergyco.com

2023 HEAT PUMP WEBINARS

Webinar Instructor

David Petroy, NTS Energy LLC

dpetroy@ntsenergyco.com

- Owner – NTS Energy *(Home energy solutions consulting: HVAC, Solar, EV.)*
- Consultant – Xcel Energy
  - Customer Personalized Energy Use Education, EVs.
- Sustainability Manager – Golden Aluminum *(Large CO industrial power user)*
  - Facility wide energy monitoring system
  - Energy saving upgrades on large industrial production
- Founder/President – Blue Valley Energy *(HVAC company focused on ground source and mini-split heat pump engineering design & installation)*
- Lead, Technical Sales – RMS Electric *(solar & energy power systems)*
- MS in Geophysics – Washington University, St. Louis
- BS in Zoology – SUNY, Oswego

NTS ENERGY

Topics

- The dramatic advancement of heat pump systems
- New Home heating and cooling strategies with air source heat pumps
- Heat pump systems first costs vs conventional strategies.
- Heat pump system operating cost savings.
- Sizing heat pump systems for comfort and performance
  - Supplemental heat options and sizing
- Important Installation Tips
- Rebate programs & local incentives

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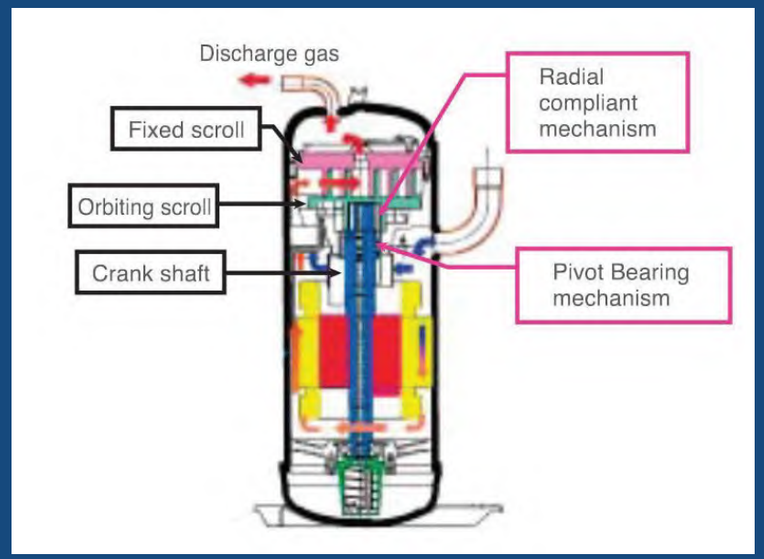
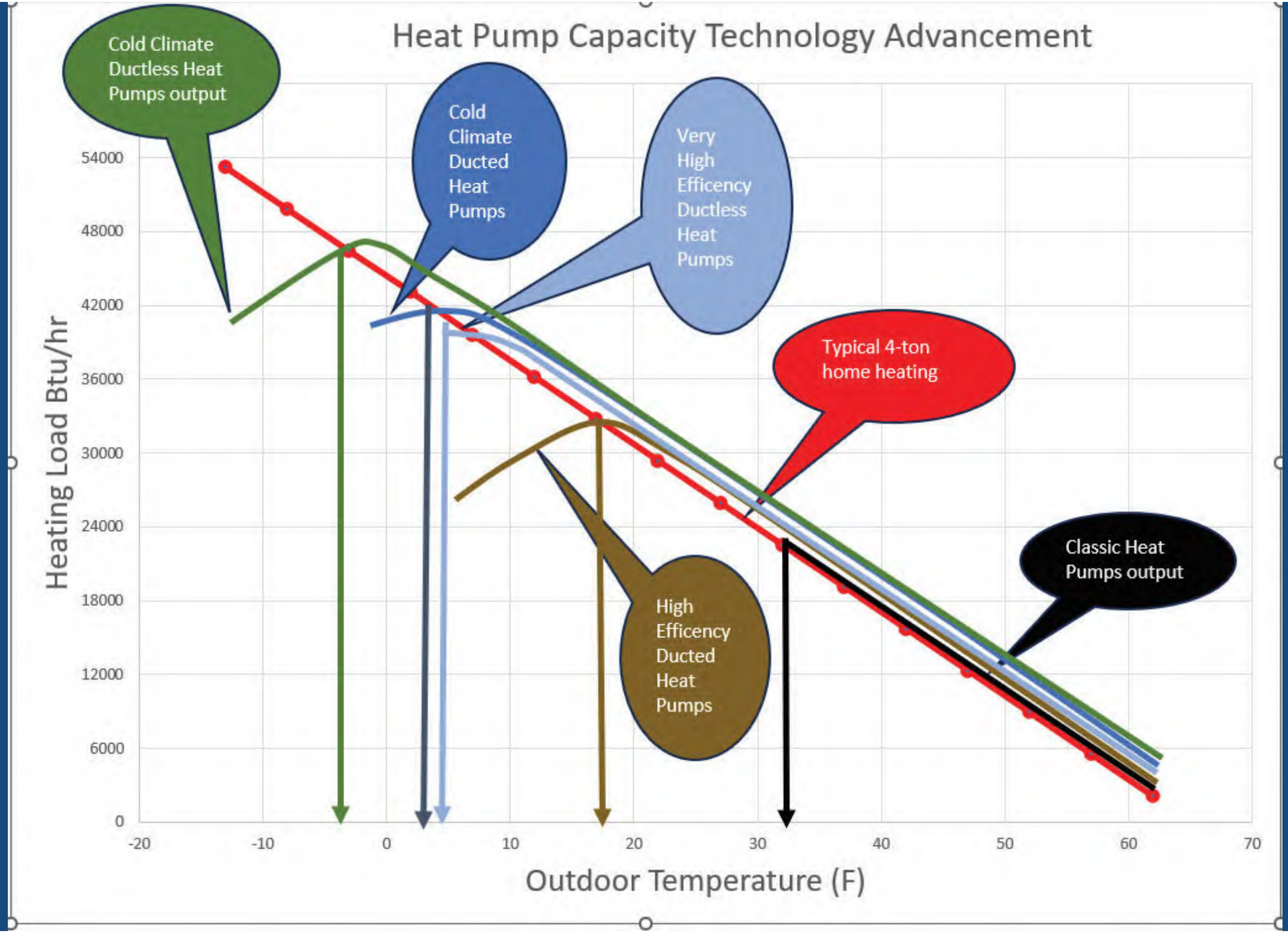
Cold Climate Heat Pump Technology

~2005 Birth of Cold Climate Heat Pumps
2005 – 2010 – Efforts in defrosting and some research field trials.
2012 – Present Day – Installed in cold climates, New England, Midwest, Canada

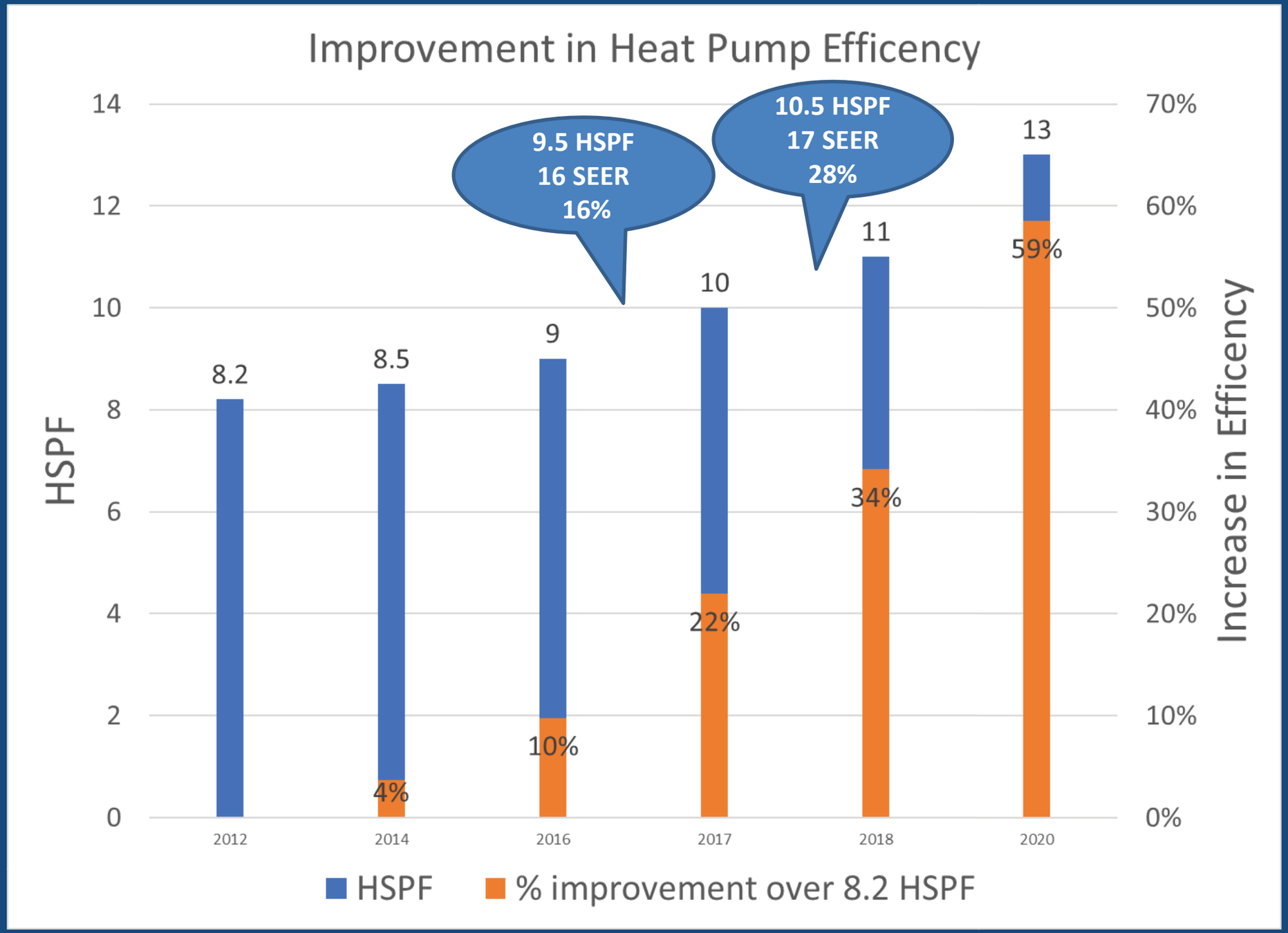


- Inverter driven scroll compressors.
- Defrosting / Hot gas bypass
- Alloys and walls of the heat exchangers.
- Fan Blade Design
- Matched capacity modulation indoor/outdoor units.


Heat Pump Capacity Technology Advancement
Cold Climate Ductless Heat Pumps output
Cold Climate Ducted Heat Pumps
Very High Efficency Ductless Heat Pumps
Typical 4-ton home heating
Classic Heat Pumps output
High Efficency Ducted Heat Pumps
Heating Load Btu/hr
54000
48000
42000
36000
30000
24000
18000
12000
6000
0
-20
-10
0
10
20
30
40
50
60
70
Outdoor Temperature (F)

Conversion to HSPF2 and SEER2

SEER – 1 ≈ SEER2
HSPF – 1.5 ≈ HSPF2



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Heat Pump Improvements Benefits Summarized

EFFICIENCY IMPROVEMENTS OF 28 – 34%

IMPROVED DEFROSTING CAPABILITIES

HIGHER CAPACITIES AND EFFICIENCIES BELOW 30F

CAPABILITY TO PROVIDE HEATING BELOW 0 F

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Air Source Heat Pump Centric HVAC Strategies

Air Source Heat Pump Whole House Ducted Systems.

- **HVAC contractor familiarity.**
- **Duct system complications to construction process.**
- **Homeowner acceptance**

Mini Split Ductless Heat Pump System for the Whole House.

- **Some HVAC contractor familiarity.**
- **No ducts. Less space conflicts and potential delays.**
- **Homeowner indoor unit acceptance.**

Boiler Radiant In-floor Heating in Combination with Mini-split Multi-zone

- **Simpler strategy to add cooling to certain areas of the home.**
- **Spring/Fall high efficiency and comfort benefits.**
- **Homeowner indoor unit acceptance.**

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Other HVAC Strategies

Ground Source Heat Pump

Option to consider.

1) Manual J heating load ~5 tons or greater.
2) Less than 5 tons air source heat pumps nearly always the more economical choice.
3) It is the highest first cost option.
4) Lower heating/cooling costs than air source heat pumps by 20-25%

Limited installation contractors in Colorado: 3-5 vertical loop field drillers. 8-10 contractors.

Notable cost variability depending up location (potential high mobilization costs) and site geology.

Air to Water Heat Pump

Option to consider:

1) Radiant in-floor heating high priority
2) Heating load 2-3 tons (cost 2-3x boiler)
3) Heating load ~5 tons or greater, all electric or combo with boiler to reduce NG use by 80%+.

Limited designer and installation resources in CO: 2-3 designers and <10 installation contractors.

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System Goals

- System must qualify for most/all the rebates
- Prime Directive - No homeowner/HVAC Contractor problems.
  - System must have the capacity to keep the homeowner comfortable under all weather conditions.
  - Contractor comfortable with the installation strategy
- Find the best value system balancing first cost vs energy use vs operating cost vs selling advantages.

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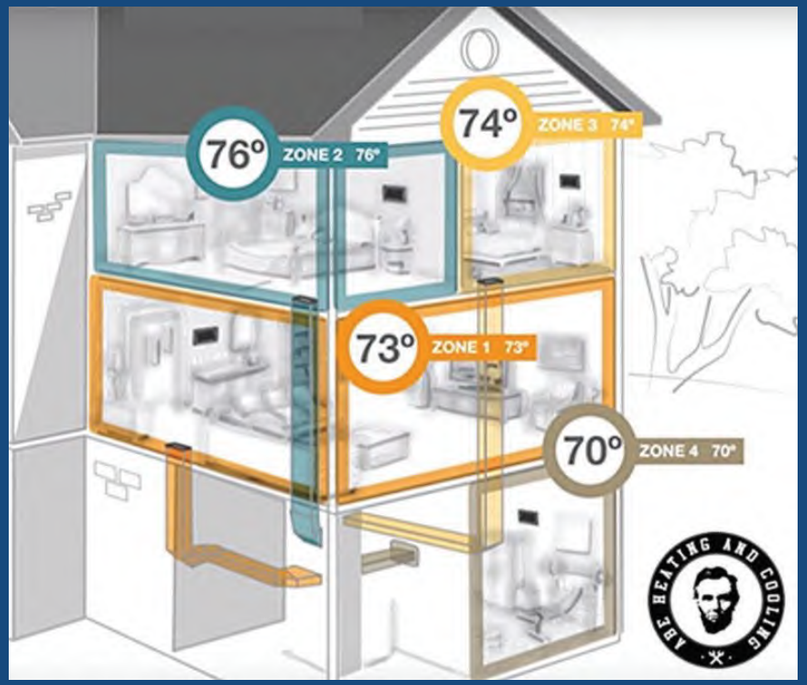
House Design & Customer Priorities Determine the Best Strategy

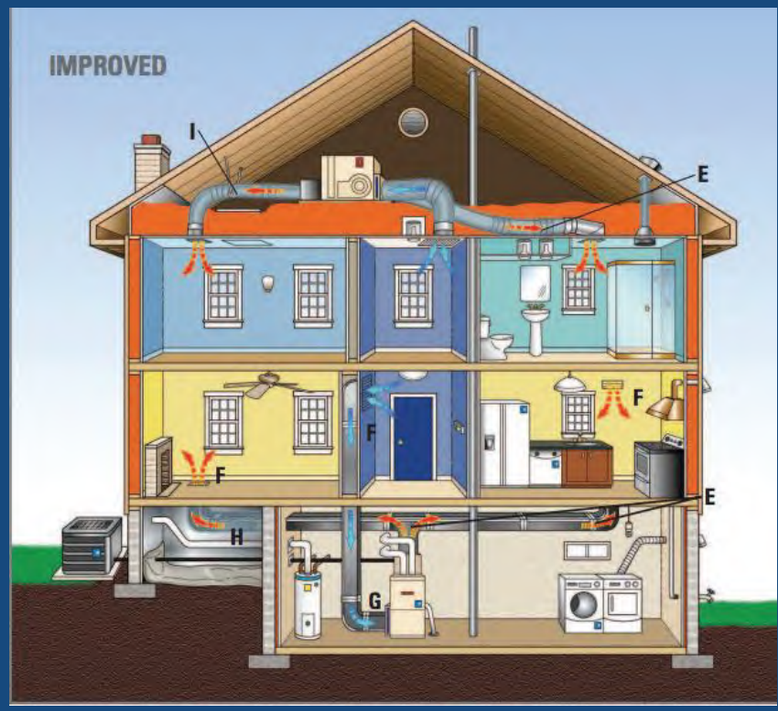
Home design and layout – Evaluate Each Floor

- **Main Floor**
  - Open concept or traditional
  - Traditional ducts from below or above
  - Do I want drops and chases for ducts.
- **Second Floor**
  - Attic availability for 2nd floor ducting.
- **Basement**
  - Finished/Unfinished. Uses: Bedrooms, TV room, laundry, workshop



Whole House Traditional Ducted Systems

- **One Level Home**
  - One system with one condenser outside and one air handler in the basement to heat/cool the main floor with 2 or three thermostat controlled zones.
  - Filter and heat recovery fresh air system can integrate easily with the system.
  - Very small vents into basement, add select electrical for comfort.



- **Multi-Level Home**
  - Two heat pump systems. One with an outdoor condenser and air handler serving the main floor another system serving the 2nd floor.
  - One system with vertical duct and 3 zones a potentially lower cost option but decreases comfort and efficiency.
  - Recommend: 2 zones main floor, 1-2 zones 2nd floor.
  - Very small vents into basement, add select electrical for comfort.

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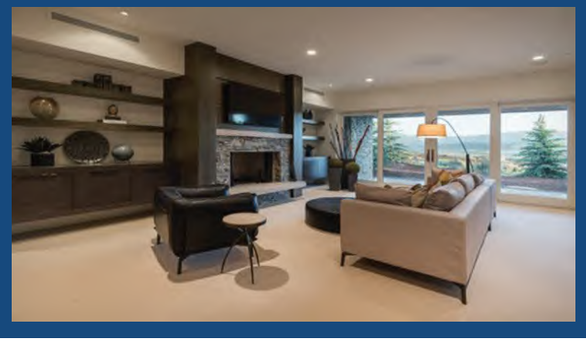
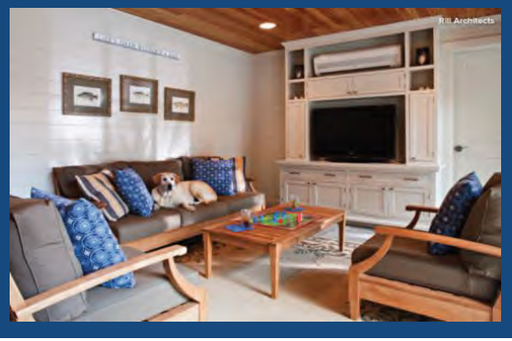
Multiple indoor unit options – Wall, Floor, Ceiling, Slim Duct

Homeowners/ Architects	Lukewarm	Like	Lukewarm	Tolerable	?
Contractors	Like	Lowest	Lukewarm	Low	Like?

Calling all architects – need some help making wall units look good.





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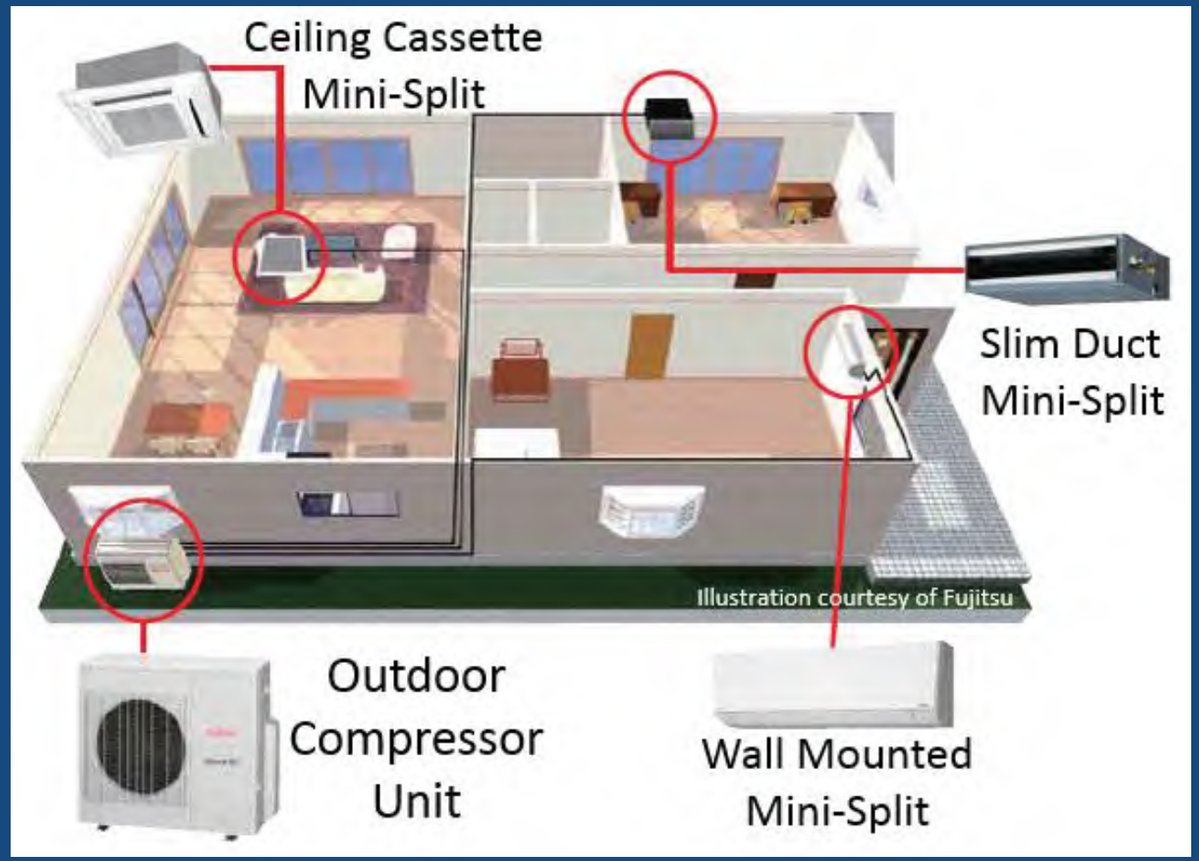
Whole House Mini Split Heat Pump System



- Good single heat pump strategy for small 1-2 bedroom homes, or homes with no spacing for ducting.
- Typically, 2 to 3 indoor heads per outdoor unit. Can go 4 but more sizing constraints.
- Use electric baseboard/flat wall heaters for bathrooms and other small rooms with very low loads.
- Maximize use of slim ducted unit to heat two adjacent bedrooms with one indoor unit and short ducts to each.
  - Locate in drop ceiling closets and bathrooms.
- Careful indoor unit placement for good airflow. On exterior walls is easier but not necessary for condensate and refrigerant runs.

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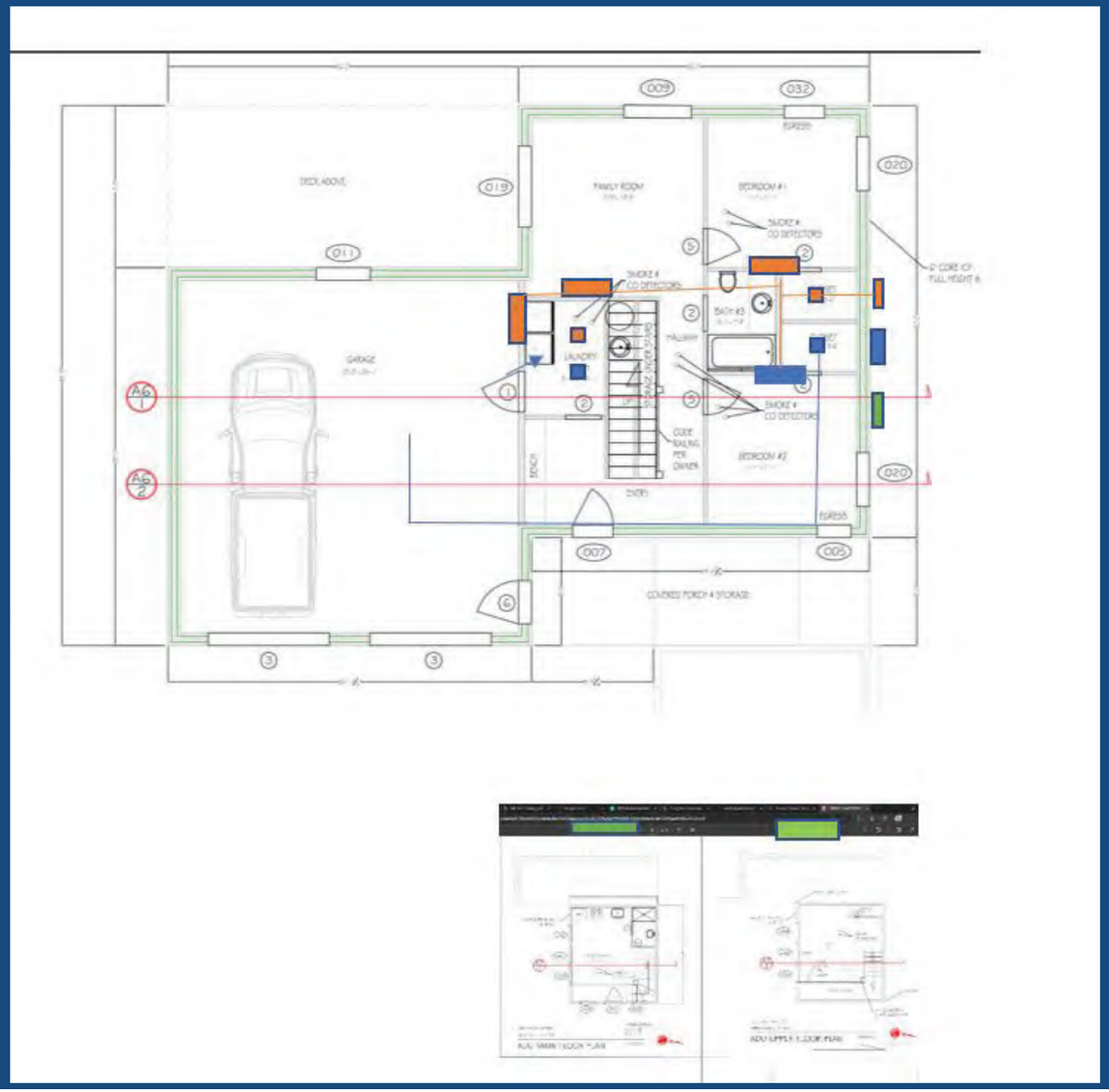
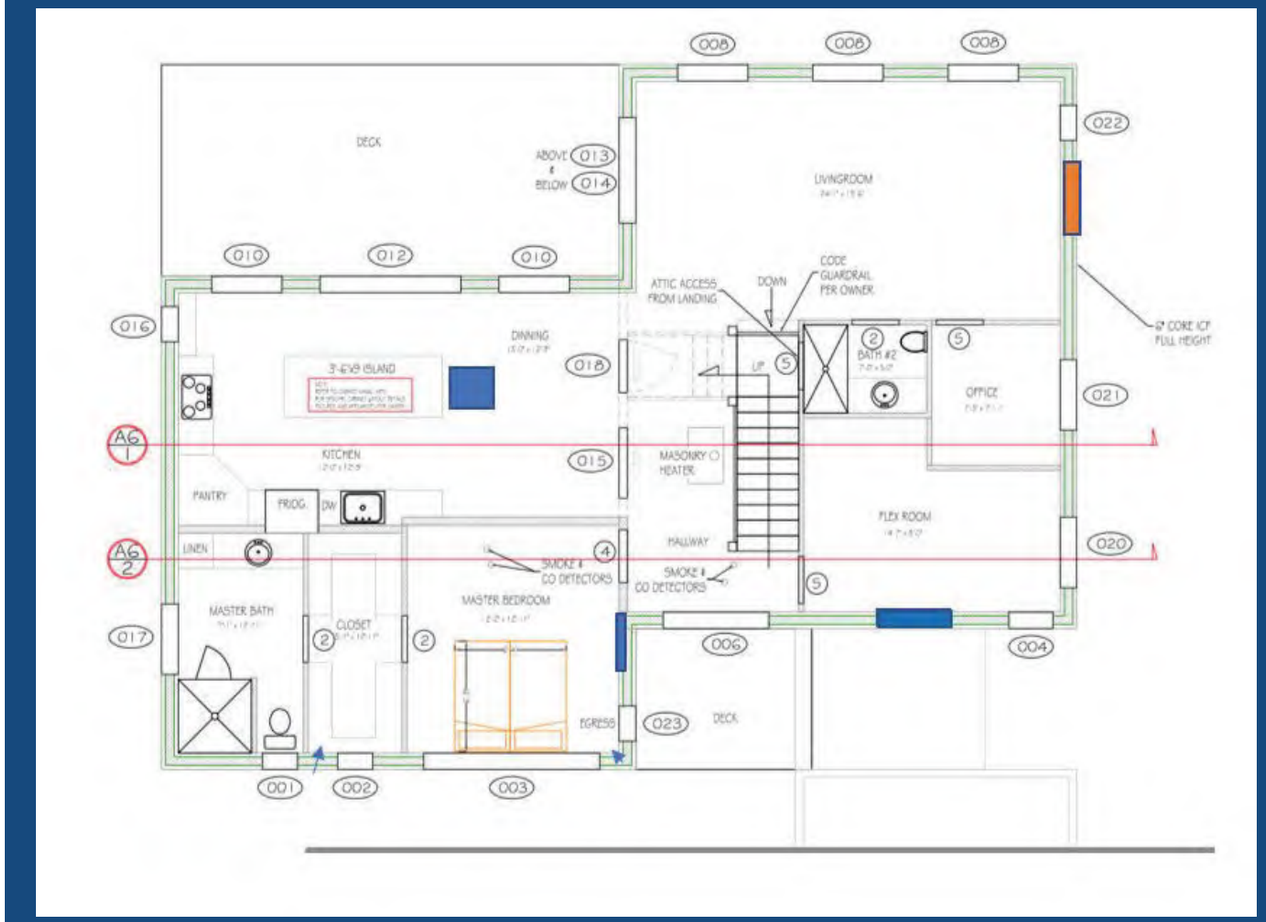
Mini-split Example





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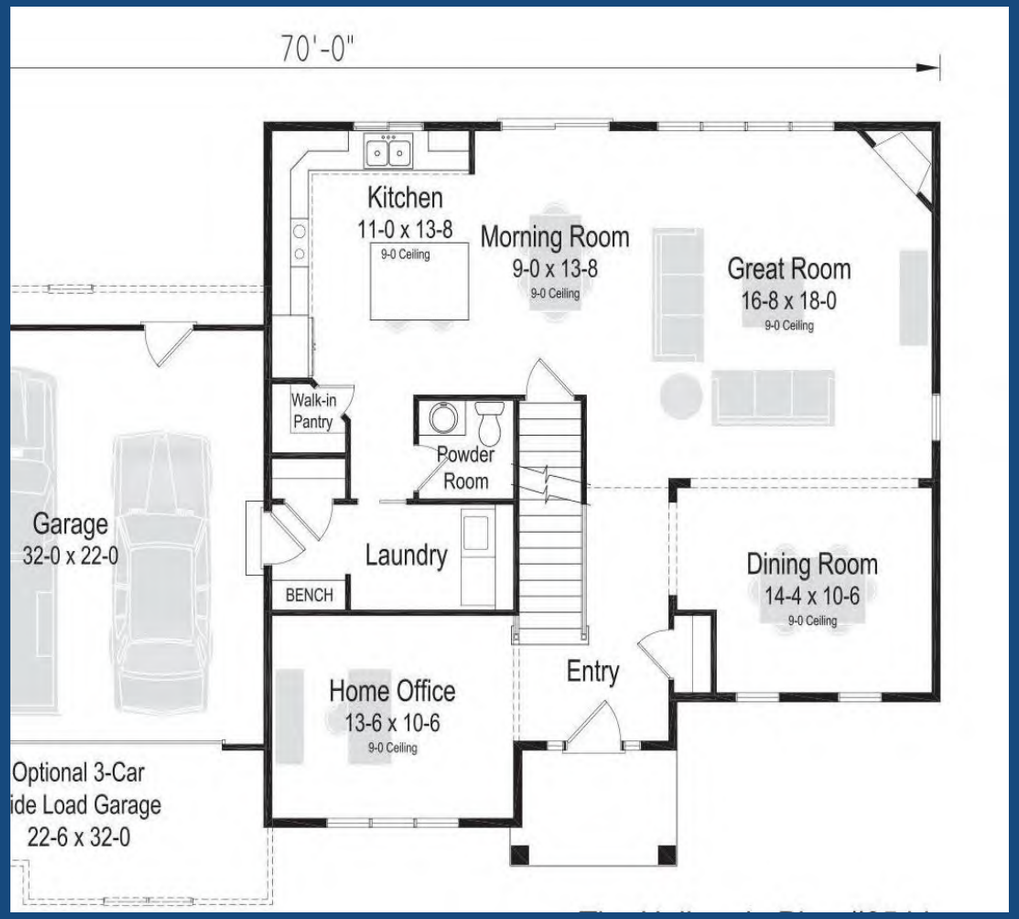
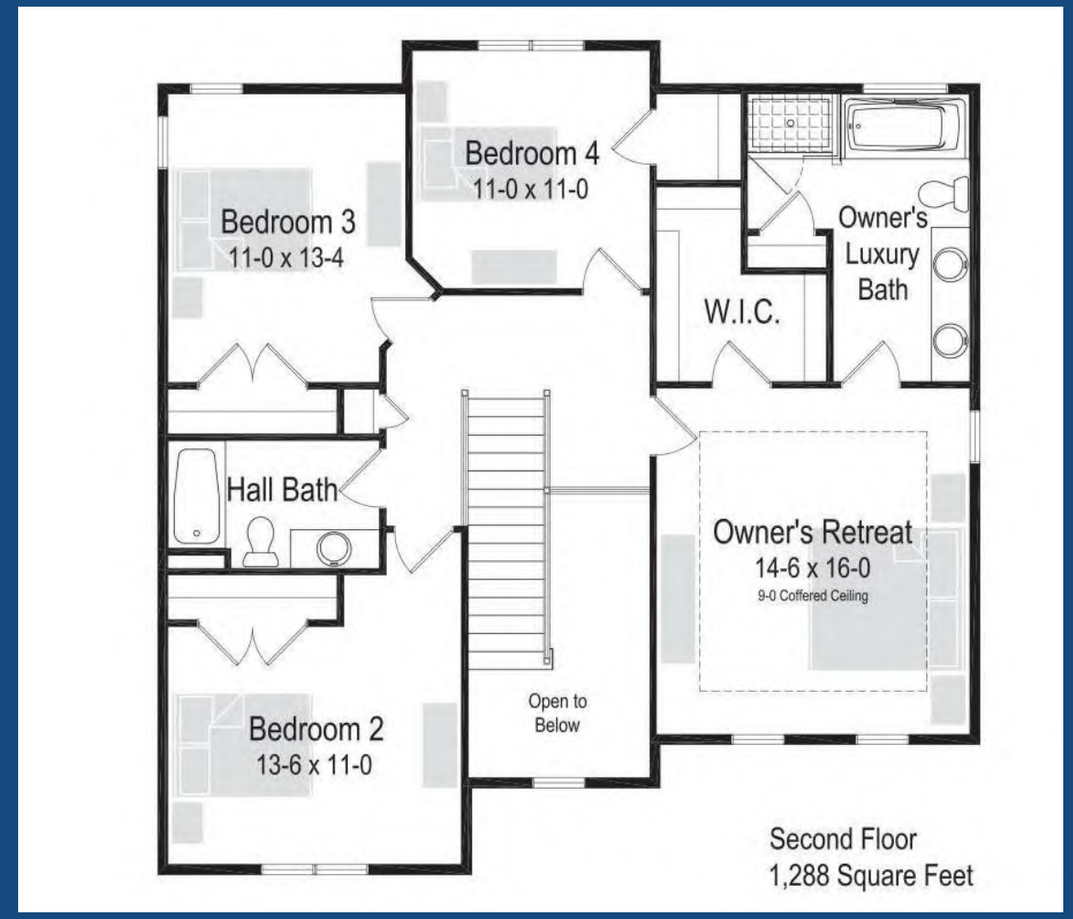
Combo multi-zone mini-split and ducted system





Unfinished basement – Ducted System two zones.
Finished basement – Mini-split system 4 units.

Attic – Ducted System.
No Attic – Mini-split system with 3 or 4 units.

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Combo multi-zone mini-split and radiant in-floor system

How important is radiant to the customer?

- Less necessary than in the past for optimal comfort with well built and insulated homes which no longer feel cold.
- Where is radiant important enough to pay for? House, floors, rooms?
- Where is cooling important? House, floors, rooms?

Balanced Strategy for radiant comfort and energy efficiency:

- Mini-split system as the primary heating/cooling system for spring, summer and fall.
- Radiant system as the primary heating system in the winter. NG on site.

The flexibility to add radiant to only rooms where radiant type comfort is a priority.

- Mini-split units provide good excellent heating comfort in rooms where cooling is a priority. Radiant heating is not necessary.
- Mini splits on the south (warm) side of the home, radiant on the north.

The bathrooms and other small rooms don't need mini-split unit and are best as radiant only.

Basement only needs a very small amount of heat from Radiant in-floor system. Does require a fresh air HRV system.

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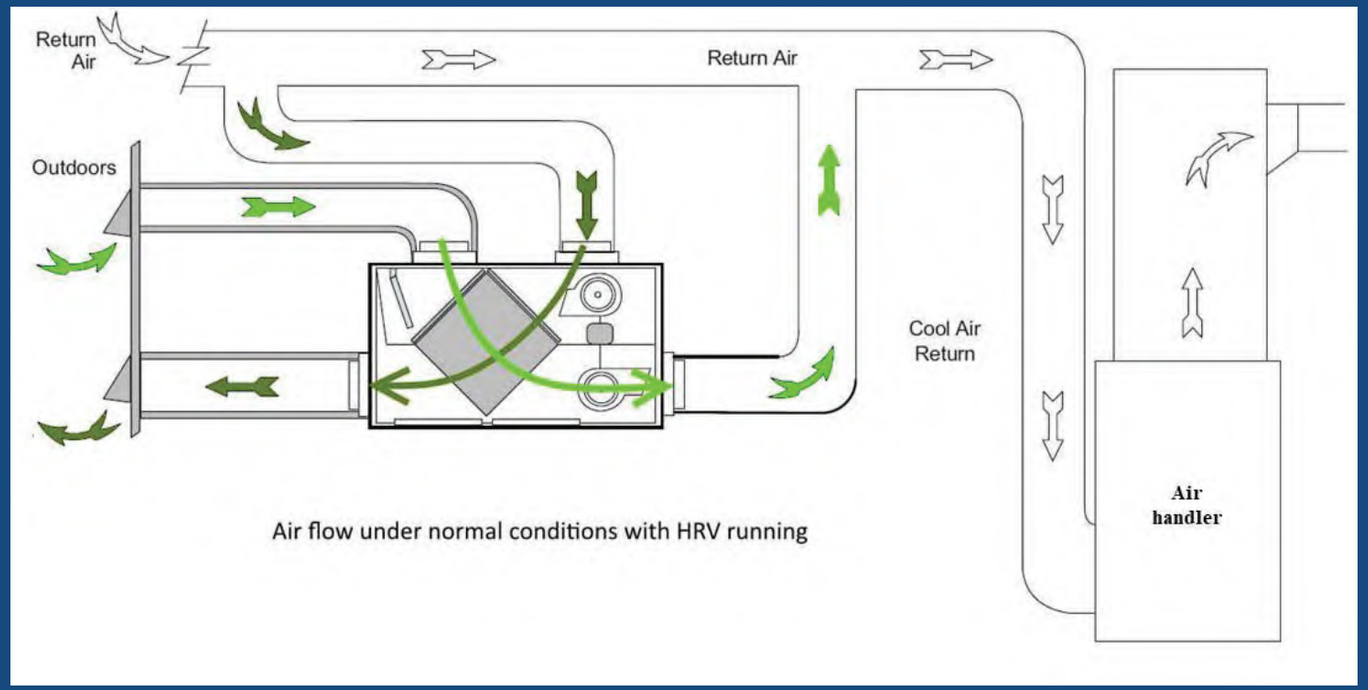
HRV Fresh Air System

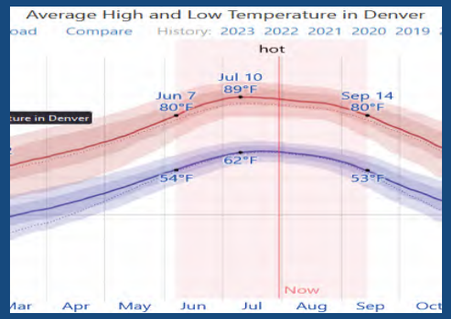
- Essential in new well-built homes. Very cold, hot or smokey conditions.
- Heat Recovery Ventilation System. Brings in Fresh Air and Exhausts Old Air while keeping much of the heat or cool. 60-75% heat recovery.
- If there is no ducting fresh air can be integrated with a small separate duct system or as part of your exhaust air system.



Whole House Fans

Something Worth Presenting For Homeowner Consideration

- In the summer cooling months, most nights the temperature drops below 70F, especially in the high country. Cools the home from the daytime setpoint temperature in the low 70s to the low to mid 60's.
- Cost to cool your home 5-10F at night with whole house fan ~$0.15
- Cost to cool your home 5F during the day with HP/AC ~$3.50
- Fan annual savings (~60 days year): $175 - $225 / yr
- This would be in addition to your primary cooling system.
- Quiet – not the old whole house fans of the past.
- Installed cost $2K-$3K



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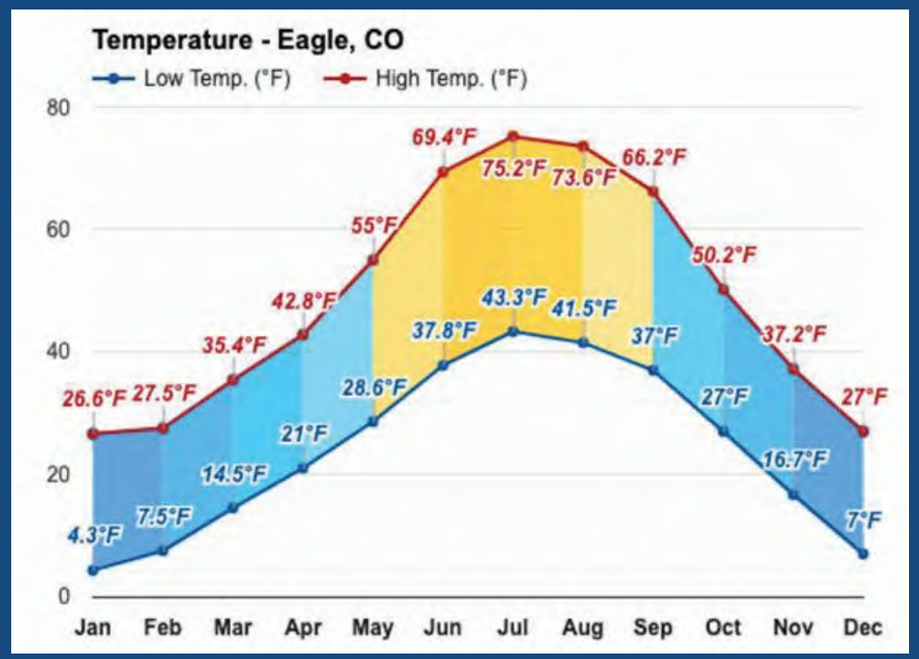
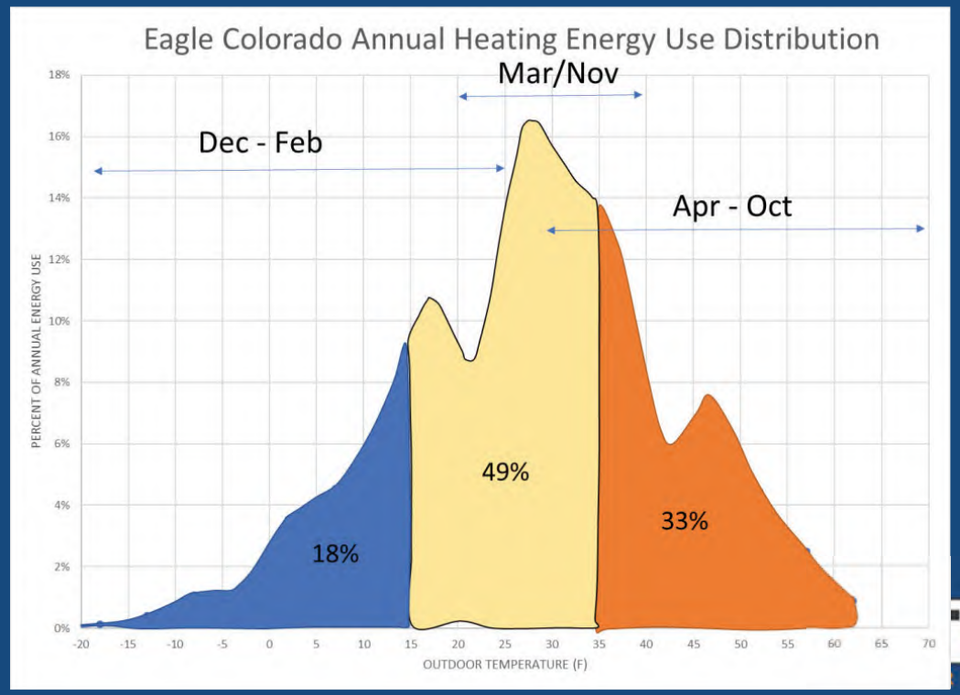
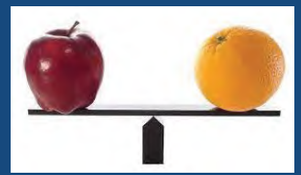
Heating Cost Savings Heat Pump vs Furnace, Boiler or Electric Baseboard

- Propane/Natural Gas – COP .95, Electric heat – COP 1, Heat Pump – COP 3
- Heat pump uses only 33% the energy of other heating systems.
  - You will save 65-70% heat pump vs all electric heating , no matter what the price of electricity.
  - You will save 65–70% heat pump vs propane at current propane prices and >50% when propane is low.
  - You pay 10% less to 10% more annually with a full heat pump system vs all-natural gas heating system.
    - Depends upon your natural provider and recent winter pricing ($.81 Xcel, $1.03 Colorado average price. Winter 2022).
    - For a typical home this is $10-$20 a month difference either way.
    - In the spring and the fall heat pumps cost much less to heat your home even with low gas prices.







Apples to Apples
First Costs, Rebates, Tax Credits

Product Level	System Efficiency	System	Cost difference before rebates and tax credits	Relative Cost difference after rebates and tax credits
1	SEER 15-17, 1 or 2 speed	92-95% furnace and AC		No longer financially beneficial to install AC instead of HP
1	SEER 15-17, HSPF 8-9 1 or 2 speed	92-95% furnace or Air Handler and heat pump	$2,500 - $3,000 more	$500 - $1,500 less
2	SEER 18+, Variable Speed AC	95-98% furnace and AC		
2	SEER 18+, HSPF 9+ Cold Climate	95-98% furnace or Air Handler and heat pump	$3,500 - $4,000 more	$500 less to $500 more

Product Level Two Systems are about $5K+ more than product level 1 systems.
Comparing the cost of a level 1 AC/Furnace to a product level 2 Heat Pump system will distort the cost.

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Savings, Cost, Payback vs Propane

Eagle Colorado
House Size: 2000 sq.ft. / 4 ton

System Option	Annual Heating Cost: Propane Furnace	Heat Pump with Air Handler	Heat Pump with Propane Furnace	Annual savings vs propane
Propane Furnace	$3,692			
Propane Furnace and AC	$3,692			
Heat Pump with Air Handler		$1,743		$1,949
Heat Pump with propane furnace			$1,684	$2,008

System Option	Annual savings vs propane	System Cost before rebates	Walking Mountains Rebate	Holy Cross Rebate	State Tax Credit	Federal Tax Credit	System Cost after rebates	Payback vs replace propane furnace (yrs)
Propane Furnace		$ 12,000					$ 12,000	
Propane Furnace and AC		$ 22,000					$ 22,000	
Heat Pump with Air Handler	$1,949	$ 24,000	$ 3,000	$ 5,000	$ 1,000	$ 2,000	$ 13,000	0.5
Heat Pump with new propane furnace	$2,008	$ 23,000	$ 3,000	$ 5,000	$ 1,000	$ 2,000	$ 12,000	0.0
Add cold climate Heat Pump to existing furnace	$1,707	$ 18,000	$ 3,000	$ 4,500	$ 1,000	$ 2,000	$ 7,500	4.4

Leave furnace in place

Eagle House: Electricity $.11/kwh, Propane $2.30 gallon

NTS ENERGY

Savings, Cost, Payback vs NG

Eagle Colorado
House Size: 2000 sq.ft. / 4 ton

System Option	Annual Heating Cost: NG Furnace	Annual Heating Cost: Heat Pump with Air Handler	Annual Heating Cost: Heat Pump with Natural Gas Furnace	Annual savings vs natural gas	Natural Gas Use Reduction
Natural Gas Furance	$1,306				
Natural Gas Furnace and AC	$1,306				
Heat Pump with Air Handler		$1,743		($437)	100%
Heat Pump with NG furnace			$1,205	$101	80-90%

System Option	Annual savings vs NG	System Cost before rebates	Walking Mountains Rebate	Holy Cross Rebate	State Tax Credit	Federal Tax Credit	System Cost after rebates	Payback vs replace propane furnace and AC
Natural Gas Furance		$ 12,000					$ 12,000	
Natural Gas Furnace and AC		$ 22,000					$ 22,000	
Heat Pump with Air Handler	($437)	$ 24,000	$ 3,000	$ 5,000	$ 1,000	$ 2,000	$ 13,000	HP system cost lower by a few thousand dollars
Heat Pump with NG furnace	$101	$ 23,000	$ 3,000	$ 5,000	$ 1,000	$ 2,000	$ 12,000	
Add Cold Climate Heat Pump to existing furnace	$86	$ 18,000	$ 3,000	$ 4,500	$ 1,000	$ 2,000	$ 7,500	HP cost slightly lower than AC

Eagle House: Electricity $.11/kwh, NG $.83/therm

Is it a Good Heat Pump System Design
Critical things to know

1. Avoidable HVAC system problems.
2. Ducted systems
    1. Technology Capabilities Uncensored
    2. The realities of Manual J-8 sizing for your climate
    3. Equipment sizing
    4. Backup realities
3. Mini-split systems
    1. Technology Capabilities Uncensored
    2. Equipment sizing
    3. Backup realities

4. Installation best practices
    1. Outdoor units
    2. Ducting
    3. Mini-split

NTS ENERGY

Avoidable Design & Installation Issues Create Heat Pump Misconceptions

- Inadequate capacity heat pump for the house/climate zone
- Manual J not used for sizing.
- Design temperature for sizing incorrect for the climate zone
- Undersized outdoor units, indoor units and/or duct system
- Poorly installed / commissioned system.

Resulting Technology Misconceptions

- Heat pumps don’t work when it’s very cold
- Heat pump heating costs were much more than expected.

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Whole House Ducted ASHP Systems

Heat Pumps Technology Capabilities Uncensored

Cold Climate HP - Minimum outdoor operating temperature range is ~-5F (0 to -10F)

- Technical specifications sheets from most major manufacturers.
- The manufacturer rated capacities for cold climate heat pumps are all specified at 5F outdoor temperature
- Mitsubishi, Samsung: Minimum outdoor operating temperature -13F
  - Notable drop off in capacity at -13F from rated (25% or more)
  - Mitsubishi 3-ton nominal max

High Efficiency Heat Pumps Have Capacity to meet full house loads in the range of 15F to 25F

Maximum Nominal Capacity is 4 tons

- Technical specifications sheets from most major manufacturers.
- Cold climate heat pumps capacity at 5F outdoor temperature is 90-100% of nominal.
- There are no true 5-ton systems from major manufactures.
- There are only a very few options that are slightly above 4 tons.

Actual Maximum Capacity in Colorado at Altitude for Largest Available Heat Pump Systems

- Climate Zones 4-5, elevation 5500’ - ~3.25 tons.
  - » Front Range/Eastern Plains/Western Slope (Climate Zones 4-5)
- Climate Zones 6-7, elevation 7500’ - ~3 tons
  - » Colorado high country

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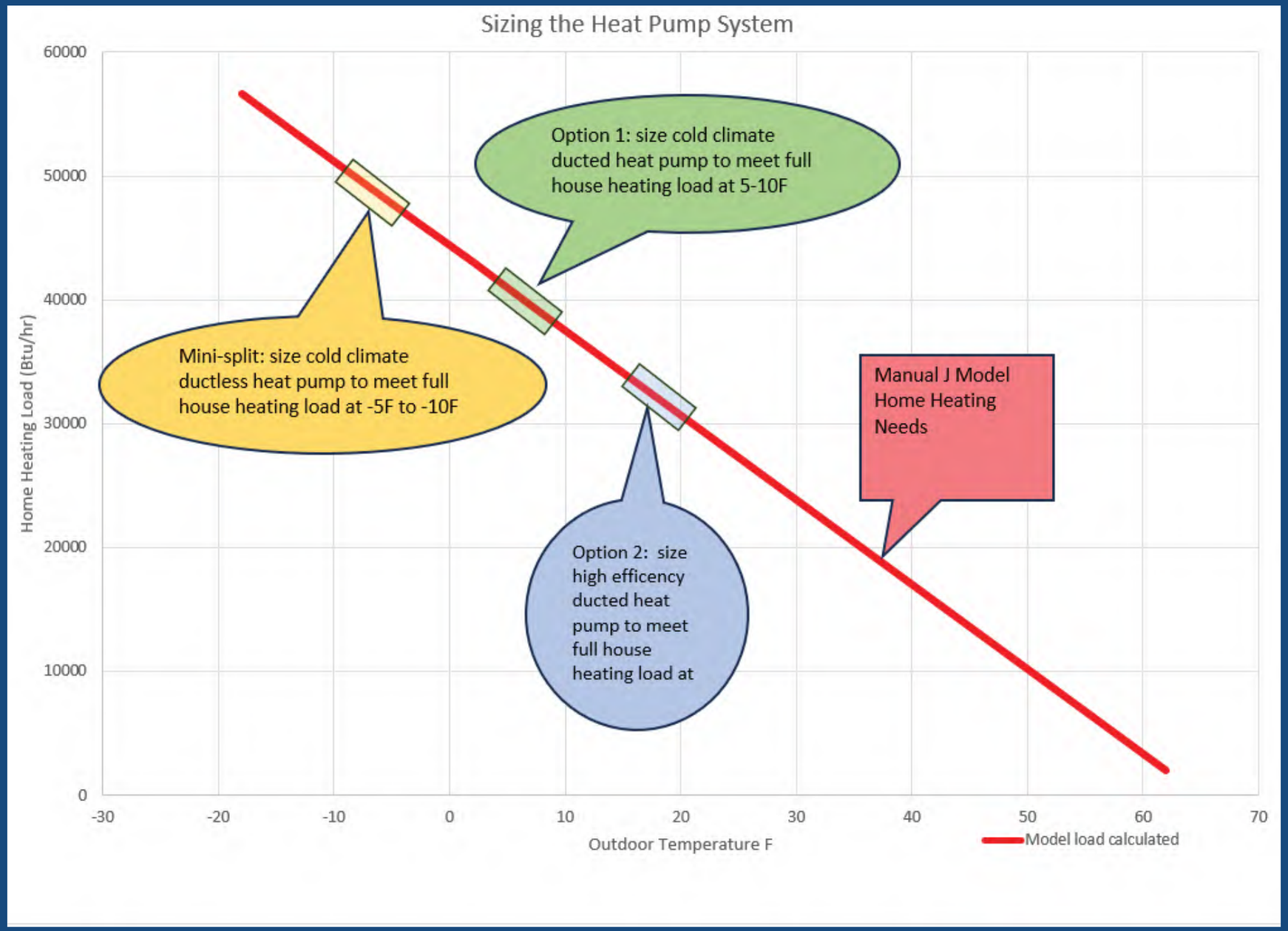
Sizing the Heat Pump System
Home Heating Load (Btu/hr)
60000
50000
40000
30000
20000
10000
0
-30
-20
-10
0
10
20
30
40
50
60
70
Outdoor Temperature F
Model load calculated
Option 1: size cold climate ducted heat pump to meet full house heating load at 5-10F
Mini-split: size cold climate ductless heat pump to meet full house heating load at -5F to -10F
Option 2: size high efficency ducted heat pump to meet full house heating load at
Manual J Model Home Heating Needs

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Heat Pump System Sizing

House load (3/3.5 tons or less at 5F)

Quality shell and insulation to reduce heating loads.

Manual J load modeling

- Standard design temperature. (Example: Eagle -6F, Denver -1F)
- It is also very important to evaluate the loads at 5F, -5F and -15F !!!!
- Contractors should adhere to Manual J loads. Should not assume that it is over calculating.
- Contractor will correct for reduced system capacity due to altitude (similar to furnace)

Option 1: Size a ducted cold climate heat pump system to meet the heating loads down to 5F-10F.

- System will heat at >50% capacity down to the units minimum outdoor operating temperature (~-5F).
- When in doubt upsize the system.
- For all supplemental heating configurations, see details later in presentation.

Option 2: A dual fuel system with efficient heat pump and natural gas or propane furnace

- Size the heat pump to meet full house heating load down to 15F-20F.
- When in doubt upsize the system.
- Only suitable supplemental heating configurations for this option are natural gas furnace or propane furnace.

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Heat Pump System Sizing - High Country House load (4+ – 6 tons at 5F)

- Two heat pump systems with electrical as the secondary heating.
  - Split by floors or vertically.
- One heat pump system with natural gas or propane furnace as the secondary heating.
  - Furnace will handle heating at <20F, 20-30% of the annual heating.
  - Heat Pump will still do 70-80% of annual heating

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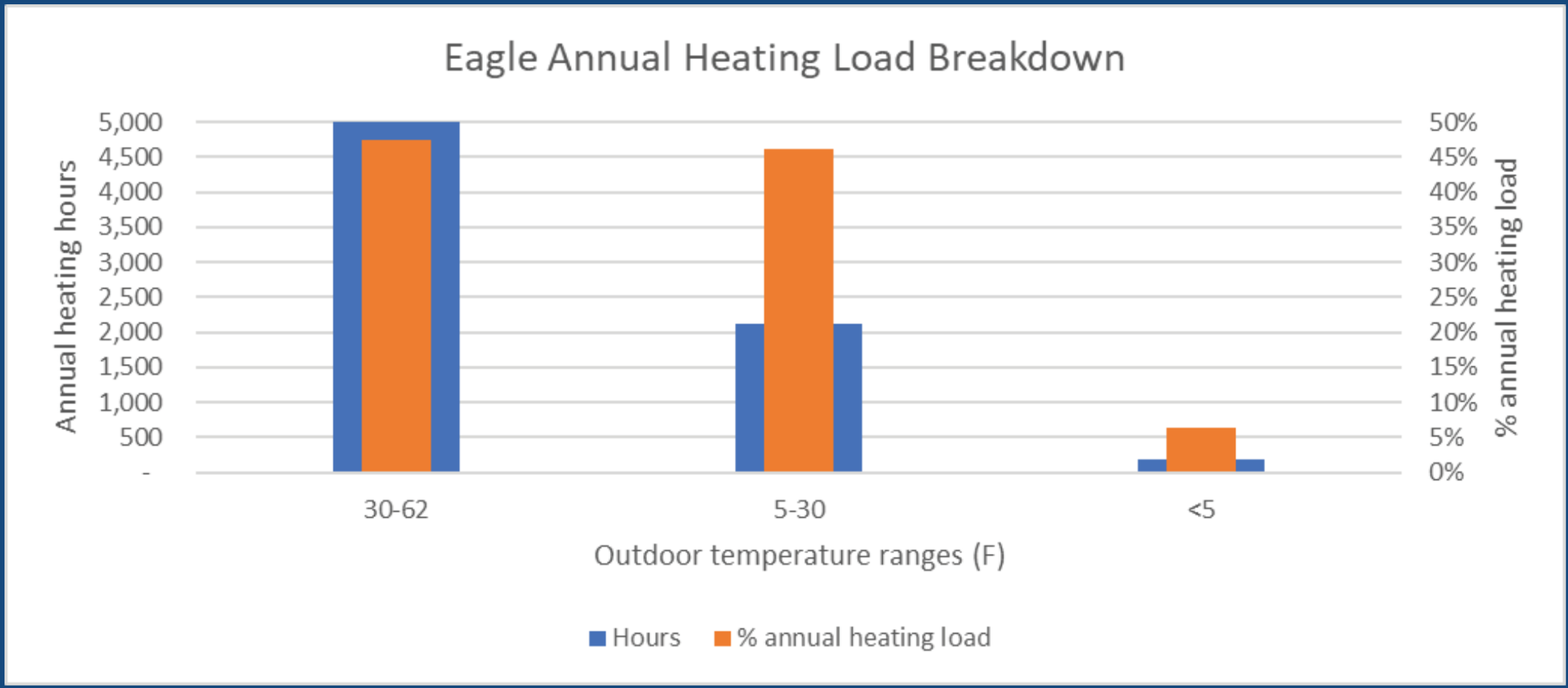
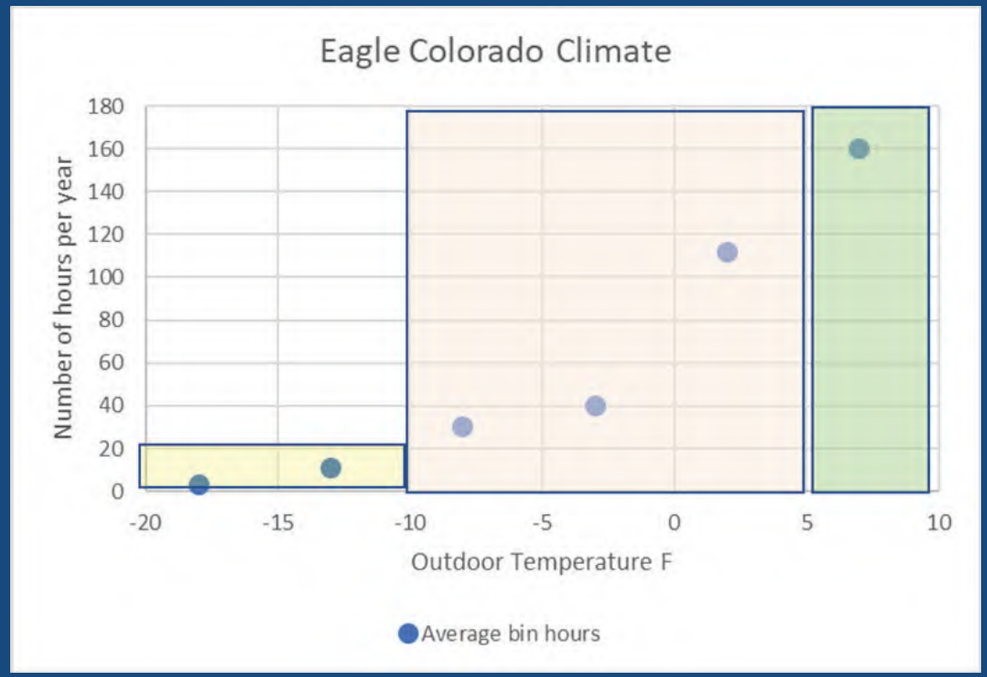
Eagle, Colorado
Annual Heat Load Bin Analysis



Ducted Heat Pump Systems Need Supplemental Heating Source

	Average year hours below 3F				Average year hours below 3F	
Outdoor Temp (F)	**Front Range/Eastern Plains/Western Slope (Climate Zones 4-5) Elevation <7000 ft**	Auxiliary source heating strategy		Outdoor Temp (F)	**High Country (Climate zones 6-7) Elevation <7000 ft)**	Auxilary source heating strategy
2	42	Mostly HP, little backup		2	110	Mostly HP, little backup
-3	20	HP & backup combo		-3	37	HP & backup combo
-8	9	backup		-8	23	backup
-13	7	backup		-13	8	backup
-18	3	backup		-18	3	backup
-23	1	backup		-23	0	backup
Total	**82 (74-90)**			**Total**	**181 (163-199)**	
	Denver Stapleton ASHRAE 2017				Eagle County Regional ASHRAE 2017	



Supplemental Heating Strategies

If you decide to have Natural Gas on site

- NG furnace as supplemental heating source
- All Colorado Climate Zones: size the furnace for heating load at -20F or local requirements.
- Furnace electronics and fan can be run with home dedicated power wall 1-2 days.

If you decide to not to have Natural Gas on site – 2 golden rules.

- *The system must keep the house heated comfortably even during a polar vortex of -20F.*
- *It is wasteful and very costly to upgrade electrical panels, wires, transformers from 200amp to 400amp for electrical backup for 50-200 hours year*

No natural gas backup options:

- 5-10kW electric strip heat plus a wood pellet stove, masonry stove, wood fireplace.
  - *Sharing 50amp circuits with EV charging is cost effective but limited to 10kW strip heat maximum*
    - *10KW is up to ~2.25 tons of heating capability when adjusted for altitude in fan unit.*
  - Here is a off the self device (<$1,000) to share EV charging and HP strip heat. *www.simpleswitch.io*
  - *Smart electric panel.*
- Propane furnace. Little propane use generally <100 gallons/yr.
  - Only 125-gallon tank (climate zone 4-5)/250-gallon tank (climate zones 6-7).
  - Size the furnace for heating load at -20F or local requirements.
  - Furnace electronics and fan can be run with home dedicated power wall 1-2 days.

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How to know you are getting a good ducted heat pump system?

- What is the HSPF/HSPF2? Higher the better. > 1 HSFP difference is notable.
- What is the SEER/SEER2? Higher the better. >2 SEER difference is notable.
- Operates at outdoor temperatures at least to zero per your climate zone.
- What is the warranty. Particularly the compressor warranty.
- Is it one of the contractors' primary brands that they install often?
- Are there distributors in Colorado that carry the product line?
- Does it meet the utility, state, federal and other local energy organizations requirements for rebates.
  - Level 1 - High Efficiency.
  - Level 2 (“Cold Climate”, “Variable speed”, “Variable capacity”)

Cold Climate Brand Examples

- Carrier Infinity, American Standard AccuComfort, Lennox Signature.

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Mini-Splits Technology Capabilities Uncensored & Outdoor Unit Sizing

Cold Climate Mini-Split Systems Minimum Outdoor Temperature -13F

- Capacity 95-100% at 5F, 80%+ at -13F.
- Mitsubishi Hyperheat, Daikin Aurora, LG LGRED, Fujitsu Halcyon XLTH

Very high efficiency “inverter” Mini-Split Systems Minimum Outdoor Temperature 5F

- Good option for some retro-fits with limited electrical capacity,because of lower power requirements than cold climate.
- Cold climate better option for new homes.

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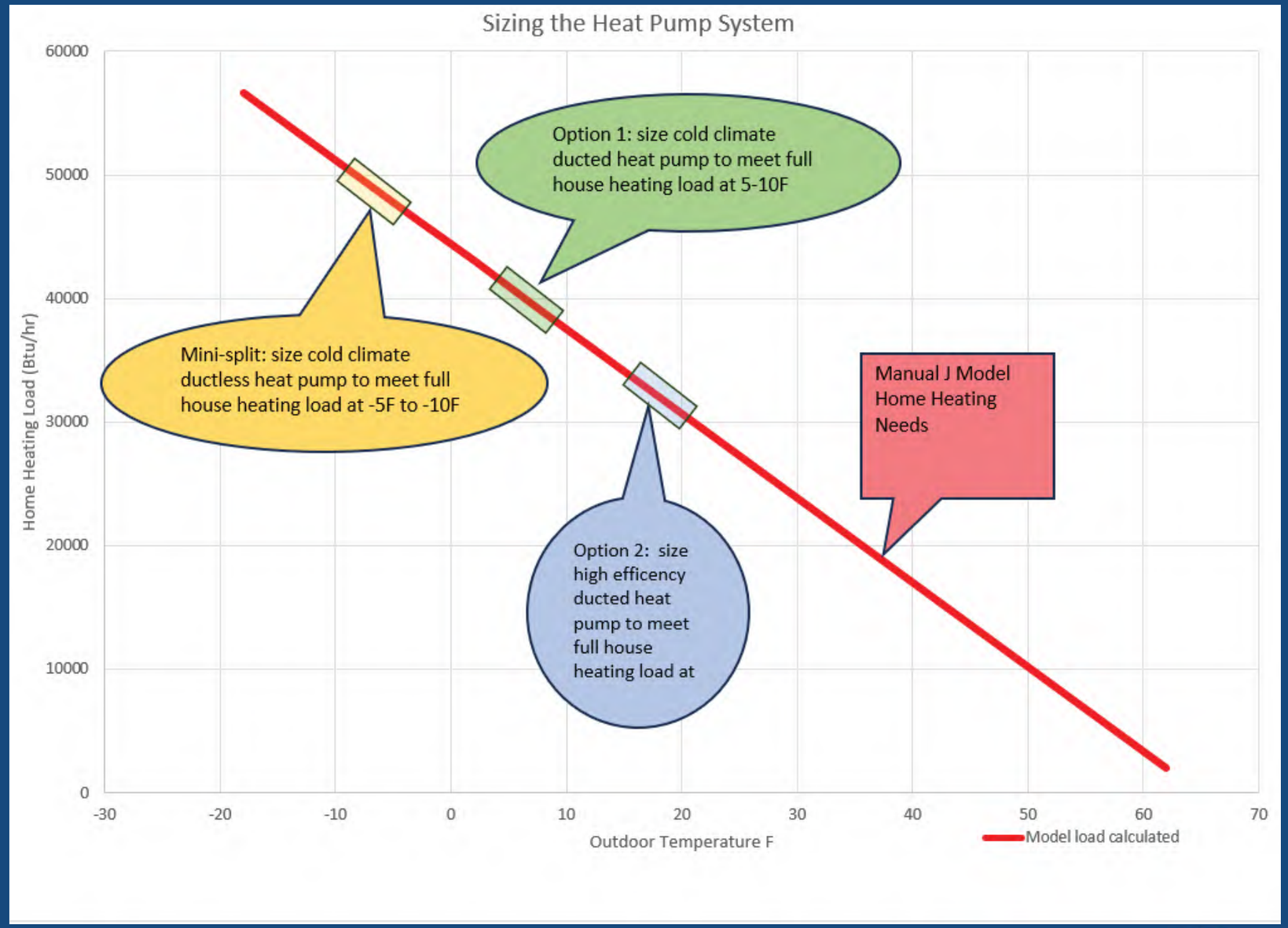
Size the Cold Climate mini-split heat pump capacity to fully heat the home to -5F to -10F.

- This applies in all Colorado Climate Zones.
- Capacity must be derated for altitude.
- If house load is between sizes, select the higher capacity size.



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Mini-Split Indoor Units Sizing

- Use Manual J – method to determine how much heating each room requires.
- Both the indoor units and the outdoor unit's capacity needs to be derated for altitude. Eagle County 78% of sea-level specification for indoor units. Outdoor unit less and varies by mfg.
- Size the mini-split indoor units to fully heat the room down to -13F.
- If the room load is between two unit sizes always go for the bigger size unit (typically ¼ ton).
- 2-3 indoor units per one outdoor unit is the best trade-off between first cost and efficiency. Generally, the indoor units should be within 1 ton of each other.
- 4 indoor units is possible, but the indoor units should be very close in capacity.

Indoor Unit Tons	Btu/hr	Model	Room
.5	6,000	060	
1	12,000	012	Small bedroom
1.5	18,000	018	
2	24,000	024	Master bedroom
2.5	30,000	030	
3	36,000	036	Kitchen/ Living Room
3.5	42,000	042	

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Cold Climate Ductless Heat Pumps Systems Supplemental Heating Usually

	Average year hours below 3F				Average year hours below 3F	
Outdoor Temp (F)	**Front Range/Eastern Plains/Western Slope (Climate Zones 4-5) Elevation <7000 ft**	Auxiliary source heating strategy		Outdoor Temp (F)	**High Country (Climate zones 6-7) Elevation <7000 ft)**	Auxiliary source heating strategy
2	42	HP		2	110	HP
-3	20	HP		-3	37	HP
-8	9	HP, little backup		-8	23	HP, little backup
-13	7	HP, little backup		-13	8	HP, little backup
-18	3	Backup needed?		-18	3	backup
-23	1	Backup needed?		-23	0	backup
Total below -5	**20**			**Total**	**44**	
	Denver Stapleton ASHRAE 2017				Eagle County Regional ASHRAE 2017	

Maybe no backup required for the climate zones 4-5, front range, eastern plains or western slope (case by case basis). Only 2-4 nights below -10F

Climate zones 6-7 Colorado high country. Backup recommended: fireplace, pellet stove, masonry stove, small electric.

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Good Outdoor Unit Installation Improves Performance

- Best location for unit is on the south side your home. Sun helps defrost.
  - East and West are fine. Avoid the north side if possible.
- If practical install some soft or hard landscaping to protect from west winds.
- Mount the unit at a height above the average snow depth of the maximum month (Jan)
  - Vail – 31” Feb, Rifle – 4” Jan
- Put a snow shelter on the top of the unit
  - Side flow units the shelter can be close to the top of the unit.
  - Top flow units need 24” clearance.
- Line set well insulated and minimize the run length. Protect condensate line.
- Effective drain pan heater and drain to safe location.
- Noise considerations: Patios, bedroom windows. Vibration: wall mounts need damping. Equipment noise specs.

Important duct system installation Tips

- **Ducts should be very well sealed and insulated**
- **Ducts need to be sized to work well with heat pump systems.**
  - Slightly different than ducted for furnace and/or AC.
- **Understand the zoning system.**
  - It the duct system laid out so that the zoning is relatively easy.

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Mini Splits Indoor Units Installation Tips

- Try to keep the refrigerant line runs to a minimum.
  - Insulate refrigerant lines separately.
- Condensate Lines.
  - No kinks/sags in the lines. Appropriate pumps.
  - In unconditioned spaces: well insulated.
- Recessed ceiling units, slim ducted:
  - Insulate on top and around unit.
  - Consider a remote thermostat

Summary

- Heat Pump based HVAC systems are rapidly becoming the standard in new Colorado homes.
- Cooling, enhanced comfort, energy savings, lower local and climate pollution, cost competitive
- Heat pump systems are either much lower or on par with conventional system heating costs.
- There are now other excellent heating and cooling strategies for new homes.
- Your goals & home layout will determine the best heat pump HVAC system strategies.
- Necessity for proper sizing is important and amplified in the high country.
- Quality system installation will ensure good operation year around in the harshest conditions. .

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Appendix

1. 2023 Heat Pump Webinars Calendar
2. 2023 Heat Pump Sponsors
3. Love Electric
4. Holy Cross Rebates
5. Colorado Energy Efficiency Organizations Heat Pump Rebates
6. Heat Pump Tax Credits
7. Dave Petroy – Webinar Presenter Bio
8. Electrical supplementary strip heat – sizes and power requirements
9. Strategies to minimize electric strip heat use
10. Levels of heat pumps
11. Rebates and tax credits table
12. Mini-split wall units – improving aesthetics
13. Wall unit covers – sources
14. Heat Pump outdoor unit covers

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loveelectric.org

Love Electric

Love Electric aims to accelerate the adoption of heat pumps, heat pump water heaters, and other efficient electric technologies in homes and businesses across Colorado, to lower consumer energy costs, reduce greenhouse gas emissions, and provide improved health, comfort and other benefits. Love Electric is an initiative of the Beneficial Electrification League of Colorado (BEL-CO).

For Consumers

- Get Started
- Find Rebates
- Find an Installer
- Financing
- Common Questions

Residential rebates

25% of total project cost for any qualifying project up to

$5,000/year

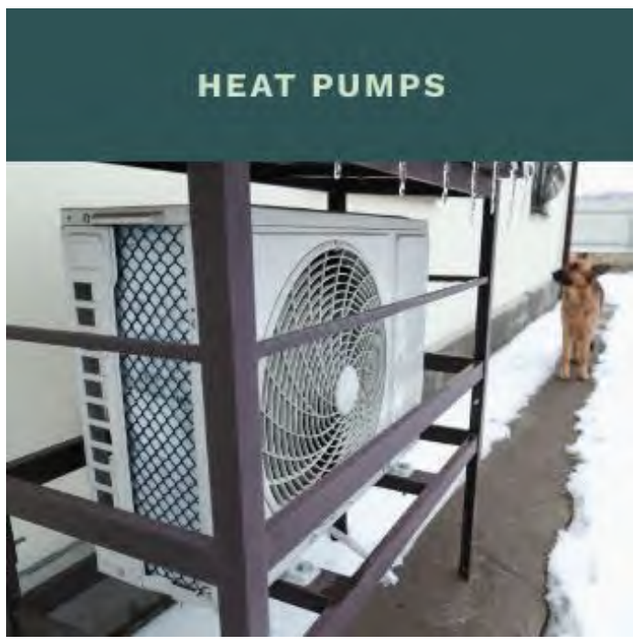
Maximum rebate of $5,000/year per account and $15,000/year per member.

New Construction Residential Rebates

25% of total cost for any qualified equipment:

$15,000/new home

www.holycross.com/rebates/#heatpumps



Ducted heat pumps must have:

- **Heating Seasonal Performance Factor (HSPF2) of 8.1+**
- **Coefficient of Performance (COP) @ 5° of 1.75+**

Ductless mini-split heat pumps must have:

- **Heating Seasonal Performance Factor (HSPF2) of 9.5+**
- **Coefficient of Performance (COP) @ 5° of 1.75+**

Other requirements:

- **Outside unit must be elevated at least 12 inches off the ground**
- **Garfield County (Climate Zone 5) = Heat pump rated to 5°F minimum**
- **Eagle County (Climate Zone 6), Gunnison and Pitkin Counties (Climate Zone 7) = Heat pump rated to -5°F or colder minimum**

Recommended: **Load calculation to right size heat pump system & derate for high elevation**

FOR YOUR HOME

Energy Saving Rebates

EnergySmartColorado

Boulder County

energySMART

Chaffee County

COLORADO CHAFFEE COUNTY EST. 1879

Eagle County including Eagle Valley

walking mountains sustainability

Garfield County

CLEER
CLEAN ENERGY ECONOMY FOR THE REGION

Gunnison County

GVRHA
GUNNISON VALLEY REGIONAL HOUSING AUTHORITY

Lake County

CLOUD CITY CONSERVATION CENTER

Roaring Fork Valley including Pitkin & Eagle Counties

CORE
Smart energy. Less carbon. More living.

Southwest Colorado including La Plata, Dolores, Montezuma, San Juan & Archuleta Counties

4CORE
Four Corners Office for Resource Efficiency

Summit County

HIGH COUNTRY CONSERVATION CENTER

Yampa Valley including Routt & Moffat Counties

YAMPA VALLEY SUSTAINABILITY COUNCIL

A home energy assessment may be required for rebate eligibility. Visit: https://energysmartcolorado.org/for-your-home for more info.

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2023 HEAT PUMP REBATES

HIGH COUNTRY CONSERVATION CENTER

$4,000

Households earning ***80-160% Area Median Income***

$500

Households earning > 160% Area Median Income

https://highcountryconservation.org/home-energy-audits

(970) 668-5703

walking mountains sustainability

***up to* $5,000**

Households earning max *150% Area Median Income*

***up to* $3,000**

Any Household

www.walkingmountains.org/energy

(970) 328-8777

CORE

***up to* $7,500**

Holy Cross Energy households

***up to* $12,500**

Aspen Electric Household

New Construction:

https://aspencore.org/core-grant

https://aspencore.org/2023rebates

(970) 233-0811

CLEER

CLEAN ENERGY ECONOMY FOR THE REGION

GARFIELD CLEAN ENERGY

***up to* $4,000**

ReEnergize Program- max *150% Area Median Income*

***up to* $3,000**

Glenwood Springs Electric Household

https://garfieldcleanenergy.org/gwse-rebates

(970) 704-9200

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Heat Pumps Tax Credit

Federal Income Tax Credits-*Existing Homes*:

- 30% of project cost up to $2,000 – Air Source Heat Pump
- 30% of project cost up to $2,000 – Heat Pump Water Heater
- 30% of project cost up to $600 – Electric Panel Upgrade
- Available years: 2023-2032
- $2,000/year limit in total for heat pumps & heat pump water heaters (additional $1,200 available/year for electric panel + other EE improvements)

Colorado Income Tax Credit:

IRA Rebates – Coming Soon!

- 10% of heat pump purchase price
- valid for purchases in 2023 or 2024
- new and existing homes
- extends to electrical panel upgrades if needed for the heat pump
- note: tax credit applies as long as the homeowner pays enough state taxes

Good sites with tax incentive information:

www.energy.gov/save/homeowners

www.irs.gov/forms-pubs/about-form-5695

www.irs.gov/credits-deductions/home-energy-tax-credits

www.energystar.gov/about/federal_tax_credits/non_business_energy_property_tax_credits

https://energysmartcolorado.org/tax-credits-incentives

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Strip Heat Sizes, Amps and Btu Output

	Amps @ 220v	Btu/hr output	Btu derated for high country When used with duct system
5 Kw strip	23	17061	13222
6 kW strip	27	20472	15866
7 kW strip	32	23891	18516
7.5 kW strip	34	25591	19833
8 kW strip	36	27304	21161
10 kW strip	45	34122	26445

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All Electric Systems - Minimize Electric Strip Use

- For strip heat that is 10kW. The system should have the ability to stage the electrical strip heat use in 5kW increments.
- If available, setup the system to efficiency rather than comfort mode.
- Keep all thermostat increases to 2 degrees.
  - Example: night setback from 68F to 64F. In the morning schedule two distinct increases 1 hour apart: 64F to 66F and 66F to 68F.

Rebates and Tax Credits

The two largest utilities in Colorado, Xcel and Tri-State G&T, and most other CO utilities have two levels of rebates. The table on the following slide shows the system requirements and includes the state and federal tax credits for comparison.

- Level 1 rebates: often referred to as Standard or High Efficiency Air Source Heat Pumps
- Level 2 rebates: often referred to as Cold Climate Air Source heat pumps

Requirement	Xcel (Level 1)	Tri-State (Level 1)	Xcel (Level 2) Cold Climate	Tri-State (Level 2) Cold Climate	CO State Tax Credit (Details in next section) (Both level 1 and level 2 systems qualify)	Federal Tax Credit (Details in following section)
Rebate	$1,500	50% of cost up to $1,800. 2+ tons	$1,800	50% of cost up to $2,400. 2+ tons	10% of the cost up to $1,000	30% of the cost up to $2,000
SEER2 or SEER	14+ 15+	14+ 15+	17+ 18+	15+ 16+	14+ 15+	15.2+ 16+
HSPF2 or HSPF	7.8+ 9+	7.8+ 9+	8.1+ 9.5+	8.5+ 10+	7.8+ 9+	7.2+ 8.5+
Must be Energy Star Certified	Yes	Yes	Yes	Yes	Yes	Yes
Must be on the NEEP Cold Climate Heat Pump List https://ashp.neep.org/#!/product_list/	n/a	n/a	Yes	n/a	n/a	n/a
Compressor Stages	n/a	n/a	variable	3+ or variable	n/a	n/a
EER	11.5+	n/a	11.5+	n/a	n/a	n/a

Factors that Impact Heat Pump Performance and Sizing

Issue	Impact on Capacity in the Field
Manual J load	+ 20% to - 5%
System Specification	Tested under perfect factory conditions
Systems as shipped from the factory	+/- 1%
High quality field installation – slight deviation from the perfect factory conditions	0 to -2%
Lineset lengths	0 to -4%
Field operation under harsh winter storm conditions	-5 to -10%
Annual performance degradation. Excellent annual maintenance.	0 to -1%
Annual performance degradation. Sporadic maintenance. (most common)	0 to -5%

Upsizing a system by ½ ton does not add much to the initial cost and the efficiency difference at milder temperatures is not significant because of the inverter compressor system.

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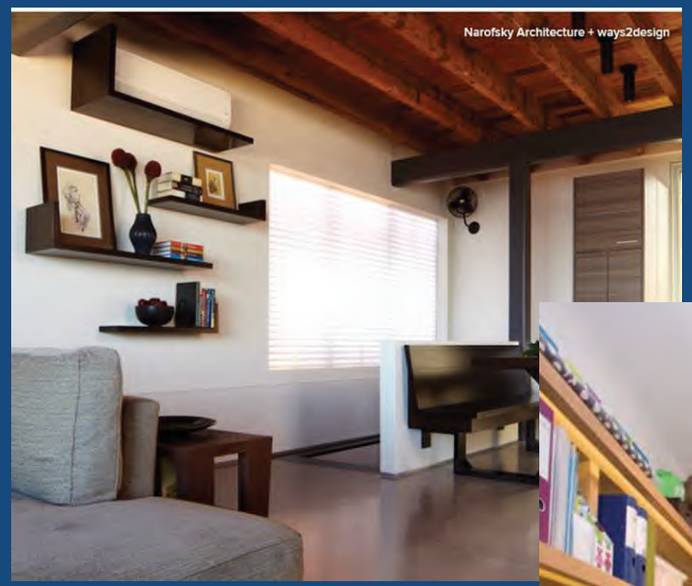
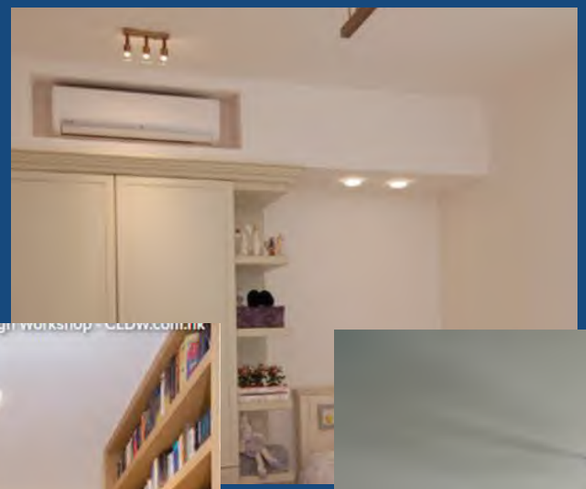
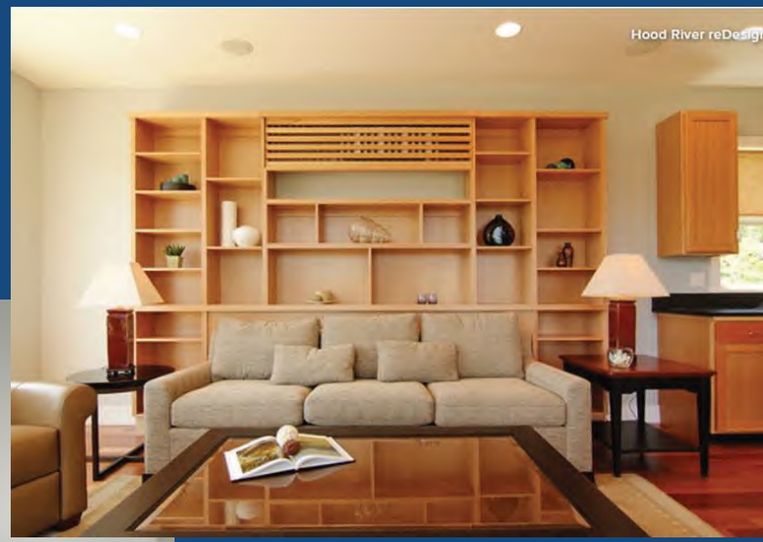
Aesthetically Integrating the Wall Unit into Your Space

Mariana Pickering July 16, 2014Houzz Contributor; Owner/CEO of Emu Building Science; LEED AP BD+C
https://www.houzz.com/magazine/10-ways-to-hide-that-air-conditioner-stsetivw-vs~29446243







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Sources/Ideas for Wall Unit Covers

https://www.pinterest.com/pin/562105597252605677/

https://woodaccover.com/

Outdoor Unit Decorative Enclosures

https://airdeko.com/#

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